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ScienceDirect

Procedia - Social and Behavioral Sciences 176 (2015) 251 – 254

Procedia
Social and Behavioral Sciences

IETC 2014

Results and outlooks of robot education in Republic of Korea

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Abstract

Approximately one century has passed since a Czech dramatist Capek Karel used a word "robot" for the first time in his satirical work "Rosumovi Univerzální Roboti (Rossum's Universal Robots)" in 1921. Indeed, the existence of a robot started with a literary imagination, when the word was used for the first time about one century ago, but the rot becomes an entity inseparable from human life, including housework and even nursing, in the contemporary society. Today, we have come to see intelligent robots going so far as not only to think and move of their own accord, but also revealing their feelings on their faces. That kind of robots is represented by ASIMO developed in 1980 by Honda in Japan, KISMET developed in the late 1990s by MIT in America, and HUBO developed in 2004 by KAIST in South Korea. Like this, robot research is currently led by Japan, the United States and the Republic of Korea. This presentation is about the robot education system currently implemented from elementary through high schools, the education results and the future prospects in South Korea. On the whole, robot education begins at college levels in America and Japan, but it is made in a systematic way after regular curricular activities at elementary schools in the Republic of Korea. In addition, more than 1000 private institutes for robot education are driving a booming trade and numerous robot competitions, including the International Robot Olympiad (IRO), are held in South Korea. Therefore, not only is the Republic of Korea expected to take the advantageous position first in the future robot education market, but the current robot education system in South Korea will be able to be a good guide for that which will be carried out throughout the world in a few years in the future.

Peer-review under responsibility of the Sakarya University.

Keywords: Capek Karel, robot, Robot Education, Republic of Korea, Rosumovi Univerzální Roboti, ASIMO, KISMET, HUBO, International Robot Olympiad

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Peer-review under responsibility of the Sakarya University.
doi:10.1016/j.sbspro.2015.01.468

1. Introduction

Approximately one century has passed since a Czech dramatist Capek Karel used a word "robot" for the first time in his satirical work "Rosumovi Univerzální Roboti (Rossum's Universal Robots)" in 1921. When the word "robot" was used for the first time at that time, the existence of robot was still nothing but a product of literary imagination. However, robots currently play an important role that is not inseparable any more from human life, including housework, surgery and war. These days, we have come to see intelligent robots going so far as to think and move on their own. They are represented by ASIMO developed in 1980 by Honda in Japan, KISMET developed in the late 1990s by MIT in America, and HUBO developed in 2004 by KAIST in South Korea. Moreover, even the robots are emerging one after another that can understand human feelings and talk with humans, as shown by "Pepper" developed by SoftBank in Japan. The Pepper lets the external server connected by Internet perform numerous arithmetic operation and data processing instead of the robot's head by introducing the method of "cloud". This makes it possible to learn and share the experiences of other robots connected with the same server. Doing so leads to a kind of collective intellect, as in the world of ants. After all, a computer draws near to humans by its own evolution.

Around the world, robotic research is led not only by America, Europe and Japan, which led a robot industry from the beginning, but by South Korea and China which recently spare no pains to invest in the industry under the recognition that it is a next-generation growth engine. The United States virtually dominated the robot industry in the 1960s at the dawn of industrial robots. The Unimation, Inc. installed an industrial robot for the first time at GM's automobile parts factory in 1962. Thereafter, Yaskawa, Nachi-Fujikoshi, Fanuk etc. in Japan rushed into robot business one after the other, making every effort possible to catch up with the US level of robot industry. Europe also began to spur the development of independent robots with the advent of the 1970s. Based on solid technical ability in the field of refined machinery, West European countries built industrial robots superior to US-made ones. But with the advent of the 21st century, South Korea and China see robot industry as a future major industry and step up their investment with the acceleration of economic growth in Asia. In particular, South Korea makes great efforts to help the students of elementary, middle school, high school and college students learn robot expertise, as seen in the every-year opening of robot-related world competitions, including the World Robot Olympiad (WRO). As a result, robot learning is creating a huge boom among students in the Republic of Korea.

Based on such circumstances, this presentation aims to present the robot education system currently implemented from elementary through high schools, the education results and the future prospects in South Korea. On the whole, robot education begins at colleges in America and Japan, but systematically after regular curricular activities at elementary schools in the Republic of Korea. In addition, more than 1000 private institutes for robot education are driving a booming trade and numerous robot competitions, including the International Robot Olympiad (IRO), are held in South Korea. Therefore, not only is the Republic of Korea expected to take the advantageous position first in the future robot education market, but the current robot education system in South Korea will be able to be a good guide for that which will be carried out throughout the world in a few years in the future.

2. Robot industry in South Korea

Robot research began very late in South Korea, compared to America, Europe and Japan. As mentioned above, robot industry was dominated by the United States in the 1960s, greatly developed by Europe in the 1970s, and led by Japan in 1980s. Unlike these countries, South Korea was quite late in robot industry investment and robot education.

The Republic of Korea was burned to ashes after the Korean War (1950-1953). South Korea, whose per capita national income was no more than 65 USD directly after the Korean War, was one of the world's poorest countries that received aid even from Ethiopia and Bangladesh. In such poor conditions, a cutting-edge industry like robot industry had nothing to do with South Korea. However, ROK economy developed remarkably, as five-year economic development plan was carried out successfully four times from 1962 on. According to the IMF, South Korea recorded a per capita GDP of 24,000 USD and a foreign exchange reserve of 366 billion USD (6th ranking in the world) as of 2003. Such a remarkable economic development was greatly credited to the conglomerate (chaebol)-led growth policy of the ROK government. The ROK economy was expanded to a global level with the accelerating growth of the chaebols, such as Samsung, Daewoo, LG and Hyundai, supported by the government. However, the globalized chaebols were entangled in severe labor-management disputes from the 1980s on. They

selected an automated system using robots as an alternative to overcome them. Samsung also built a robot television production line in 1992 as the first among ROK enterprises. Thereafter, other enterprises vied for introducing robot production lines as well. The result is that South Korea is rated the third best country (US and Japan: first and second, respectively) in the world in the overall level of robot industry. South Korea also ranks fourth or so in the world in the level of learning based on the papers presented at international robot-related academic conferences. Like this, the Republic of Korea has joined a leading group of robot industry in a period as short as some 30 years since its investment.

However, the ROK's robot industry has not experienced a continuous development alone. Automobile and semi-conductor industries, which belong to South Korea's key industries, were thriving across the world in the 1980s. In this boom period, the ROK's robot industry also made rapid progress in terms of quantity. However, most chaebols closed robot business divisions in the 1990s, since there was no continuous investment or research in robot industry. As a consequence, the ROK considerably fell behind in robot industry, compared to the US and Japan. Recognizing the seriousness of the situation, the ROK's government invested in robot industry on a large scale by letting the Ministry of Science and Technology, the Ministry of Information and Communication, the Ministry of Commerce, Industry and Energy, etc. implement large robot-related projects. Especially, the field of intelligent robots has been designated as a next-generation growth engine industry and continuously invested in by the ROK government. The Mecca Center of Samsung Electronics counts as a representative chaebol manufacturer of robots, and Rotem and multiple defense industry members develop military robots. Eugene etc. are small and medium enterprises that distinguish themselves in manufacturing robots.

3. Robot education in South Korea

The intelligent robot industry is one of the ROK's ten next-generation growth engine industries. Based on excellent IT technology, the ROK's artificial intelligence robot industry is very likely to grow into a future industry. Intelligent robots are classified into the humanoid robots with artificial intelligence and the ubiquitous robotic companions (URCs) based on networking. America, the second robot producer in the world, focuses on developing humanoid robots, while South Korea and Japan focuses on developing URCs. South Korea, a holder of 384 (31.1%) URC patents, fiercely competes for the lead with Japan, a holder of 514 (41.6%) URC patents. Having rushed into robot industry much later than the US and Japan, the ROK has gone so far as to fiercely compete for the lead with Japan, the US and Europe thanks to the heated robot education from the 2000s as well as the active investment of the government and enterprises.

On the whole, robot education begins at colleges in America and Japan, but systematically after regular curricular activities at elementary schools in the Republic of Korea. This is because the ROK's parents judge that robot industry will play a pivot role in national economy in the future. The ROK's robot education is also characterized by being performed at more than 1000 private institutes across the country. Robot education comprises the various steps of definition, operating principles, manufacturing and programming. In South Korea, diverse robotic campaigns are carried out to find and foster robotic prodigies through such education and to exchange robotic research results. International robot competitions are held as part of such campaigns. The ROK organizes international robot competitions, such as ROBOT CUP and International Robot Olympiad (IRO) which began to be held in 1995 and 1999, respectively. In particular, the IRO draws so much attention that it is attended by more than 3000 persons from all over the country. The Olympiad consists of elementary, middle and high school divisions, each of which has the games of transformer, robot gathering, robot biathlon, traverse and hurdle. Held every year, the competition was held in the Republic of Korea, Hong Kong, China, Australia, Singapore, Malaysia, Indonesia, the United States, etc. In addition to the IRO, there are a variety of competitions in the ROK:

Korea International Robot Olympiad (organized by Korea Robot Soccer Association (KRSA));
Robofest Korea (organized by Robot Education Contents Association);
Robofest Asia-Pacific (organized by Robot Education Contents Association);
World Robofest (organized by Robofest Committee);
Korea Intelligent Robot Contest (organized by Korea Intelligent Robot Association);
World Robot Olympiad (organized by World Robot Olympiad Committee);
National Youth Robot Contest (organized by Government Youth Commission (GYC));

National Student Robot Contest (organized by Korea Association of Robot Education Advancement (KAREA));
SeoulTech Robot Festival (organized by SeoulTech);
Korea Robot Game Festival (organized by Incheon Information Service (INIS)).

In South Korea, robots attract such much concern from elementary, middle and high school students for three reasons: first, the ROK has attained a remarkable economic development in a short span of time after the Korean War, but is considered to have reached the limitations of development. The reason lies in that its economic growth is based on imitation by low labor costs and diligence rather than originality. Now, it forms a social consensus among Koreans that the ROK will not survive in intense international competition without originality. They consider robot education one of representative educations to improve the needed originality. Second, the prospect for robot industry is considered to be bright, as the ROK government designates robot industry as its next-generation growth engine industry. Accordingly, it appears favorable for finding jobs to have robot expertise and major in robotics in the difficult job-seeking conditions of the ROK society. Third, South Korea is world-famous for high competitive rates for college entrance exams. Therefore, it is not easy to enter prestigious universities. In such situation, students can expect to get additional points from their award-winning records at international robot contests.

4. Future prospects

Robot industry is a next-generation high value-added industry that has experienced a high growth of 10% per year from 2000 on. Given the trend, its market is expected to amount to 1 trillion and 400 billion USD and thus exceed the BT market. The robot industry centered on personal robots is expanded by the life extension and human isolation by the development of IT and BT. South Korea should compete with advanced countries using a strategy of mass-producing low-priced personal robots by combining its world's fourth industrial robot technology with the vitality of IT enterprises and the knowhow of manufacturers. However, the reality is that industrial robots considerably lag behind in distribution rate, compared to Japan and the US. Japan tries to develop various kinds of robots, such as pet robots, including Sony's IBO, errand robots, education robots and public welfare robots, but South Korea shows a huge technical gap with Japan, though its technical development ranks the forth in the world.

However, robot education is actively implemented at schools as well as more than 1000 private institutes, as investment and interest in robot industry increased in the ROK around 2000. Robotics-related departments are established at many universities, including KAIST and Kwangwoon University, which makes the outlook for the ROK's robot industry bright. Especially, various international robot competitions, including IRO, contribute to the cultivation of robotic prodigies. Such investment in robot industry will be surely a big asset fir the development of robot industry in South Korea.

In the future, the ROK's robot industry seems to be competitive in the field of the ubiquitous robotic companions (URCs) based on networking. As for humanoid robots, South Korea is considered to have great difficulty in keeping up with advanced countries, including the US due to huge technical gaps. But as far as the URC field is concerned, the ROK has already reached the world's highest level in the IT field and will have a high competitive edge, if the country applies its IT technology to robot industry successfully. As South Korea is also advanced in automobile industry, it will create a great synergy effect to combine automobile industry with IT technology and robot industry. Therefore, it will be desirable for the ROK's robot education to connect IT technology with automobile one instead of focusing on robotics alone.

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